We Claim

1. A method for reducing seam lines in replication lithographic processes, comprising:

a) providing a surface to be patterned and coated with a photosensitive layer;

b) providing an irradiation source for irradiating the photosensitive layer through a mask;

c) providing a mask defining a pattern having a pattern size that is a portion and repeating subset of the overall pattern to be defined on the substrate, said mask defining said repeating subset of the pattern and also having a repeating pattern;

d) performing a first sweep beginning at a initial first sweep position of said mask by:

1) partially exposing the photosensitive layer on said substrate by irradiating said photosensitive layer though exposure from said irradiation source as modulated by said mask to expose a first photosensitive layer portion,

2) stepping said mask across said substrate to position said mask at a second position on said substrate, and

3) repeating said sub-steps 1) and 2) until said photosensitive layer has been partially exposed over the entire surface to be patterned by stepping said mask across said substrate and exposing said photosensitive layer to produce a continuously but partially exposed photosensitive layer; and

e) performing an nth sweep, with said mask physically offset from anyone of said stepped positions of said mask produced by any previous step d)1) or d) 2) by a portion of said pattern size corresponding to a multiple of the repeating pattern to define an nth initial sweep position, said step of performing a nth sweep repeating said sub-steps 1 )-3) of step d) from the nth initial sweep position;

said steps d) and e) performing n sweeps of the entire surface to be

patterned, each of said n sweeps performing one nth of the total exposure of the entire surface to fully expose said photosensitive layer to enable patterning with reduced seam lines.

2. The method of claim 1 wherein n is 2

3. The method of claim 1 wherein n is 4.

4. The method of claim 1 wherein the initial sweep position for each of said n sweeps is 1/n of the pattern size offset from the previous initial sweep position

5. The method according to claim 1, wherein the edge of the mask is intentionally meandering to further reduce seam lines when said mask is multiply irradiated on each sweep d) and e).

6. The method according to claim 1 where said mask is a grayscale mask.

7. The method according to claim 6 where said mask is formed of High Energy Beam Sensitive (HEBS) glass

8. The mask according to claim 1 where said mask is created by e-beam or laser writing a pattern into a layer.

9. The mask of claim 1 wherein said mask is a binary mask modulating a defocused irradiation to expose the photosensitive layer with illumination varying in intensity as defined by said mask.

10. A method for producing an array of desired microstructures exhibiting reduced seam lines from plural exposures of a mask using replication lithographic processes, comprising:

a) providing a surface to be patterned, coated with a photosensitive layer;

b) providing an irradiation source for irradiating the photosensitive layer through a mask;

c) providing a mask defining a pattern having a pattern size that is a portion and repeating subset of the overall pattern to be defined on the substrate, said mask defining said repeating subset of the pattern and also having a repeating pattern;

d) performing a first sweep beginning at a initial first sweep position of said mask by:

1) partially exposing the photosensitive layer on said substrate by irradiating said photosensitive layer though exposure from said irradiation source as modulated by said mask to expose a first photosensitive layer portion,

2) stepping said mask across said substrate to position said mask at a second position on said substrate, and

3) repeating said sub-steps 1) and 2) until said photosensitive layer has been partially exposed over the entire surface to be patterned by stepping said mask across said substrate and exposing said photosensitive layer to produce a continuously but partially exposed photosensitive layer; and

e) performing an nth sweep, with said mask physically offset from anyone of said stepped positions of said mask produced by any previous step d)1) or d) 2) by a portion of said pattern size corresponding to a multiple of the repeating pattern to define an nth initial sweep position, said step of performing a nth sweep repeating said sub-steps 1 )-3) of step d) from the nth initial sweep position;

said steps d) and e) performing n sweeps of the entire surface to be patterned, each of said n sweeps performing one nth of the total exposure of the entire surface to fully expose said photosensitive layer to enable patterning with reduced seam lines; and

f) using the exposed photosensitive mask to form a desired substrate contour.

11. The method according to claim 10, wherein said step f) includes,

1) developing the exposed photosensitive layer, and

2) removing a portion of the photosensitive layer, and

3) etching a desired contour defined by the remaining photosensitive layer.

12. The method according to claim 11, wherein said step f) includes,

1) developing the exposed photosensitive layer, and

2) removing a portion of the photosensitive layer, and

3) heat curing the remaining photosensitive layer to form a solid structure.

13. The method of claim 11 or 12 wherein said method further comprises g) electroplating the desired substrate contour to form a master.

14. The method of claim 13 further comprising molding a desired contour from the master.

15. The method of claim 10 wherein the initial sweep position for each of said n sweeps is 1/n of the pattern size offset from the previous initial sweep position.

16. The method according to claim 10, wherein the edge of the mask is intentionally meandering to further reduce seam lines when said mask is multiply irradiated on each sweep d) and e).

17. The method according to claim 10 where said mask is a grayscale mask.

18. The method according to claim 17 where said mask is formed of High Energy Beam Sensitive (HEBS) glass.

19. The mask according to claim 10 where said mask is created by e-beam or laser writing a pattern into a layer.

20. The mask of claim 10 where said mask is a binary mask modulating a defocused irradiation to expose the photosensitive layer with illumination varying in intensity as defined by said mask.

21 An array of desired microstructures, having reduced fabrication seam lines, formed from the process of claims 1 or 10-14.

22. A mask for use in reducing seam lines in replication lithographic processes for manufacture of arrayed features, comprising:

a mask containing a pattern intended control irradiation passing therethrough to expose a photosensitive layer on a substrate, the pattern defining a subset of an array of features to be produced on said substrate by repeated and stepped exposure of said mask to expose the photosensitive layer to a repeating pattern defined by said mask, said mask having opposed first and second intentionally meandering edge portions that reduce seam lines between adjacent exposures of said substrate through stepped positioning of said mask.

23. The mask according to claim 22 where said mask is a grayscale mask.

24. The mask according to claim 22 where said mask is composed of High Energy Beam Sensitive (HEBS) glass.

25. The mask according to claim 22 where said mask is created by e-beam or

laser writing a pattern Into a layer.

26. The mask of claim 22 wherein said mask is a binary mask modulating a defocused irradiation to expose the photosensitive layer with illumination varying in intensity as defined by said mask.

27. The mask of claim 22 wherein all of the edges of said mask are intentionally meandering edge portions.

28. The mask of claim 27 where the meandering of the intentionally meandering edge portion is generally periodic, with a period substantially smaller than the dimension of the mask.

29. The mask of claim 28 wherein the period of the meandering is at least an order of magnitude smaller than the mask.

30. A method for reducing seam lines in replication lithographic processes, comprising:

a) providing a surface to be patterned, coated with a photosensitive layer;

b) providing an irradiation source for irradiating the photosensitive layer through a mask;

c) providing a mask defining a pattern which is a repeating subset of the pattern to be defined on said substrate;

d) exposing the photosensitive layer on said substrate by irradiating said photosensitive layer though exposure from said irradiation source as modulated by said mask to expose a first photosensitive layer portion;

e) stepping said mask across said substrate to position said mask at a second position on said substrate;

f) repeating said steps d) and e) until said photosensitive layer has been fully exposed by stepping said mask across said substrate and

exposing said photosensitive layer to produce a continuously exposed photosensitive layer.

31. The mask according to claim 30 where said mask is a grayscale mask.

32. The mask of claim 30 where the meandering of the intentionally meandering edge portion is generally periodic, with a period substantially smaller than the dimension of the mask.

33. The mask of claim 32 wherein the period of the meandering is at least an order of magnitude smaller than the mask.

34. A method for reducing seam lines in replication lithographic processes, comprising:

a) providing a surface to be patterned, coated with a photosensitive layer;

b) providing an irradiation source for irradiating the photosensitive layer through a mask;

c) providing a control for controlling the irradiation source to irradiate a pattern having a pattern size that is a portion and repeating subset of the overall pattern to be defined on the substrate, said mask defining said repeating subset of the pattern and also having a repeating pattern;

d) performing a first sweep of a portion of the pattern beginning at a initial first sweep position by:

1) partially exposing the photosensitive layer on said substrate by irradiating said photosensitive layer though exposure from said irradiation source as modulated by said control to expose a first photosensitive layer portion,

2) stepping said beam across said substrate to position said beam at a second position on said substrate, and

3) repeating said sub-steps 1) and 2) until said

photosensitive layer has been partially exposed over the entire surface to be patterned by stepping said beam across said substrate and exposing said photosensitive layer to produce a continuously but partially exposed photosensitive layer; and

e) performing an nth sweep, with said beam physically offset from anyone of said stepped positions of said beam produced by any previous step d)1) or d)2) by a portion of said pattern size corresponding to a multiple of the repeating pattern to define an nth initial sweep position, said step of performing a nth sweep repeating said sub-steps 1 )-3) of step d) from the nth initial sweep position;

said steps d) and e) performing n sweeps of the entire surface to be patterned, each of said n sweeps performing one nth of the total exposure of the entire surface to fully expose said photosensitive layer to enable patterning with reduced seam lines.